

Graduate STEM Fellows in K-12 Education: Translating Complex Science for Many Audiences

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NSF Division of Graduate Education

Graduate STEM Fellows in K-12 Education

GK-12

Preparing Tomorrow's Scientists and Engineers for the
Challenges of the 21st Century





NSF's GK-12 Program



- Provides funding for graduate students in science, technology, engineering, and mathematics (STEM) disciplines to bring their leading research practice and findings into K-12 learning settings.
- Why?
 - to *acquire skills* that will broadly prepare them for professional and scientific careers
 - in addition to being competent researchers, STEM graduate students must be able to *communicate science and research* to a variety of audiences.

How do participants benefit?

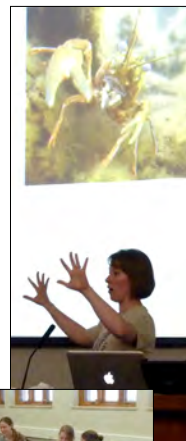
Graduate Students

Communication, Leadership,
Team Building



K-12 Education

Enhanced Teaching and Learning,
Inspire Students with Role Models



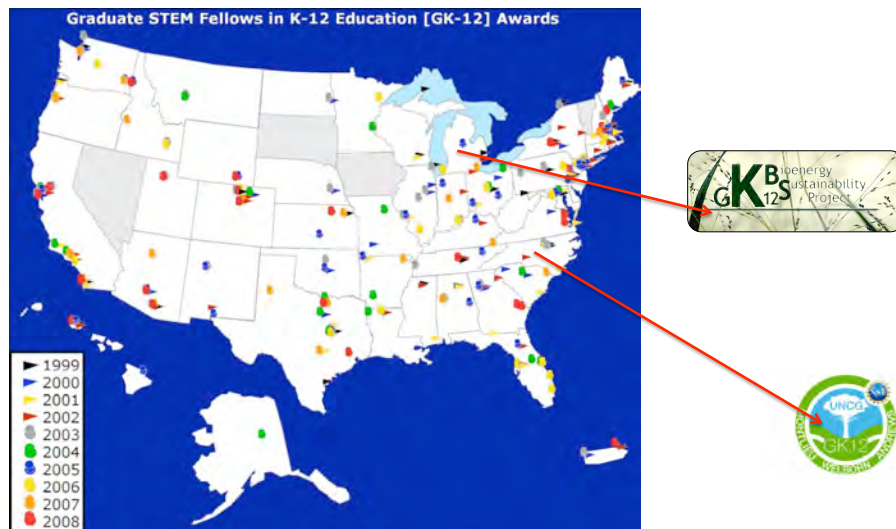
Higher Education

Transform Graduate Programs



Graduate STEM Fellows in K-12 Education (GK-12)

299 Projects at >180 Universities Funded Since 1999



But how do we do this?

Challenges:

- Broad disciplines of fellows' work
- Different and complex dissertation topics
(how to distill for different audiences?)
- Curriculum constraints
- Range of teacher experience, grade-levels taught
- Roles may be initially unclear
- Unfamiliar with one another's
scope of practice



Department of
Education



Diverse projects with common goals



- First fellow cohort 2010
- Theme: **Changing land use patterns and their socioeconomic, biological and health-related effects**
- Partner with 3 schools
- 3rd-12th grade



- First fellow cohort 2010
- Theme: **STEM dimensions of bioenergy sustainability**
- Partner with 13 school districts
- K-12th grade

Are we meeting our goals?
Summary of 1st year findings –
For fellows, teachers, K-12 students

UNC Greensboro's GK-12 Program



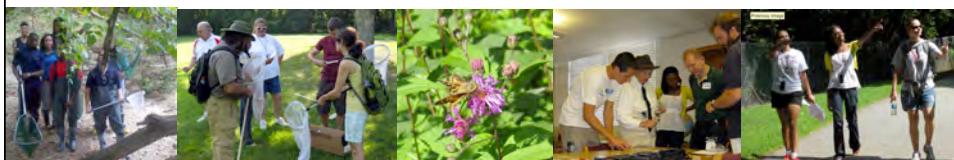
Transforming Minds in a Transitioning Community



UNC Greensboro's GK-12— *Transforming Minds in a Transitioning Community*



- Focus on historical and **changing land use patterns and their socioeconomic, biological and health-related effects** in High Point area
- Graduate research is **translated to students and teachers** by addressing neighborhood and regional environmental problems through **critical thinking skills**



UNC Greensboro Project Stats

- 9 Resident Scientists from 3 departments (Biology, Biochem/Chem, Geography)
- 9 Partner Teachers
- 3rd-12th grade
- 3 Schools on Greenway in High Point, NC





UNC Greensboro Project Goals

Teams investigate biological, chemical, physical, health-related, and socioeconomic effects of changing land use patterns in the region, taking advantage of the Greenway that runs between their schools.

Topics include: soil erosion, behavior of streams, and ecological consequences of stream pollution.



Major Project Activities



- Summer Science Institute
 - just fellows for 2 weeks: focus on translating your science, skills for classroom work
 - Partner teachers join for 3 days: address how research might be integrated into classroom
- Fellows meet with leadership team 2x/month
- Workshops with teachers 2x/semester
- Fellows spend 15 hours/week on project activities including time in the classroom



W.K. Kellogg Biological Station's GK-12 Program

STEM Dimensions of Bioenergy Sustainability



MSU Project Stats

- 10 Fellows/year
- 10 Partner Teachers in Elementary, Middle, and High School classrooms
- 13 rural school districts in SW Michigan
- 80+ Teachers
- STEM dimensions of bioenergy sustainability



Major Project Activities

- Collaborative Schoolyard Research Network
- Week-long Summer Science Institute –
 - “grad student for a day”, inquiry based lessons at intersection of fellows’ research, project theme, and MI standards
- 4 School-year workshops
 - expand teacher content knowledge and field skills, fellow-led
- Weekly Professional Development Course
 - help fellows place their research in broader societal and global contexts, science education research
- Fellows spend 15 hours/week on project activities (10 in classrooms)



From our Proposal—

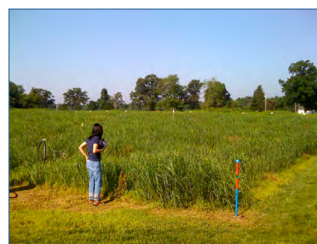


We will create a collaborative research network of schoolyard science research sites which will:

- serve as arenas for inquiry science activities,
- mimic aspects of KBS and fellows' thesis research,
- address MI Science standards
- allow K-12 classes to develop their own research initiatives,
- facilitate cross-district research collaboration



Project Theme: STEM Dimensions of Bioenergy Sustainability



GLBRC
Great Lakes Bioenergy Research Center

BIOENERGYRESEARCHCENTER

HOME | RESEARCH | EDUCATION & OUTREACH | LINKS | PEOPLE | CONTACT

WELCOME

Welcome to the website of the Michigan State University branch of the Great Lakes Bioenergy Research Center (GLBRC). This site deals only with MSU activities and contributions to the GLBRC. For the main GLBRC website please go to: www.glbrc.org.

The GLBRC is one of three national centers funded by the U.S. Department of Energy to conduct transformational biofuels research. The other centers are the [Joint BioEnergy Institute](#) and the [University of Wisconsin, Madison](#).

PARTNERS

The GLBRC is a collaboration between academia and industry. The participants include:


- [University of Wisconsin Madison](#)
- [Michigan State University](#)
- [Iowa State University](#)
- [Illinois State University](#)
- [Lucigen Corporation](#)
- [Oak Ridge National Laboratory](#)
- [Pacific Northwest National Laboratory](#)

THRUST FOUR — Development of a Sustainable Bioenergy Economy 4

For a bioenergy economy to positively impact the U.S. energy sector, it must be integrated into agricultural, industrial, and social systems. The GLBRC will develop economically and environmentally sustainable best practices for the entire biofuel production cycle.

The GLBRC leader of Thrust Four is [Philip Robertson](#), Department of Crop and Soil Sciences, Kellogg Biological Station.

Summer 2010:
Fellows introduced Teachers to
native prairie and switch grass plots
treatments



GK-12 Fellow Nikhil and teacher John Edgerton check out a **native prairie** plot at the GLBRC.

KBS K-12 Partnership teacher Sandy Erwin observes a **switch grass** plot at the GLBRC.

Summer 2010:
Brainstormed with teachers to develop experimental design
and questions/hypotheses to address in our research network

Potential questions to ask with the bioenergy plots:


The following list of questions represents all of the awesome brainstorming our partner teachers did at the Summer 2010 GK-12 workshop. They are organized such that those listed at the top are those which can be answered using the core data that everyone will be gathering from their schoolyard plots. Questions which would require additional data collection follow, separated by a dashed line. Example hypotheses (Ex Hyp) are given for many of the questions. To all of the creative teachers, fellows, and leaders who have helped create this list: **Thank you!**

Questions we can answer using the core data we will gather using protocols:

- How does productivity vary among treatments?
- How does species composition change over time within the mixed prairie?
 - Example hypothesis: Species composition will change over time with respect to perennial vs. annual plants, and legumes vs. non-nitrogen fixers
- How does species composition differ between the fertilized vs unfertilized prairie?
 - Unfertilized plots will have greater plant diversity
- Will the insect community be more diverse in the harvested or un-harvested plots?
 - Un-harvested plots will have a greater insect diversity
- Will the insect community be more diverse in the fertilized prairie plots?

Introduction

Protocols



Can we grow our fuel and our flowers and butterflies too?

Basic experimental block:
(modeled after the GLBRC)



FERTILIZED PRAIRIE HARVESTED	FERTILIZED SWITCH HARVESTED	FERTILIZED PRAIRIE	FERTILIZED SWITCH
SWITCH HARVESTED	PRAIRIE HARVESTED	SWITCH	PRAIRIE

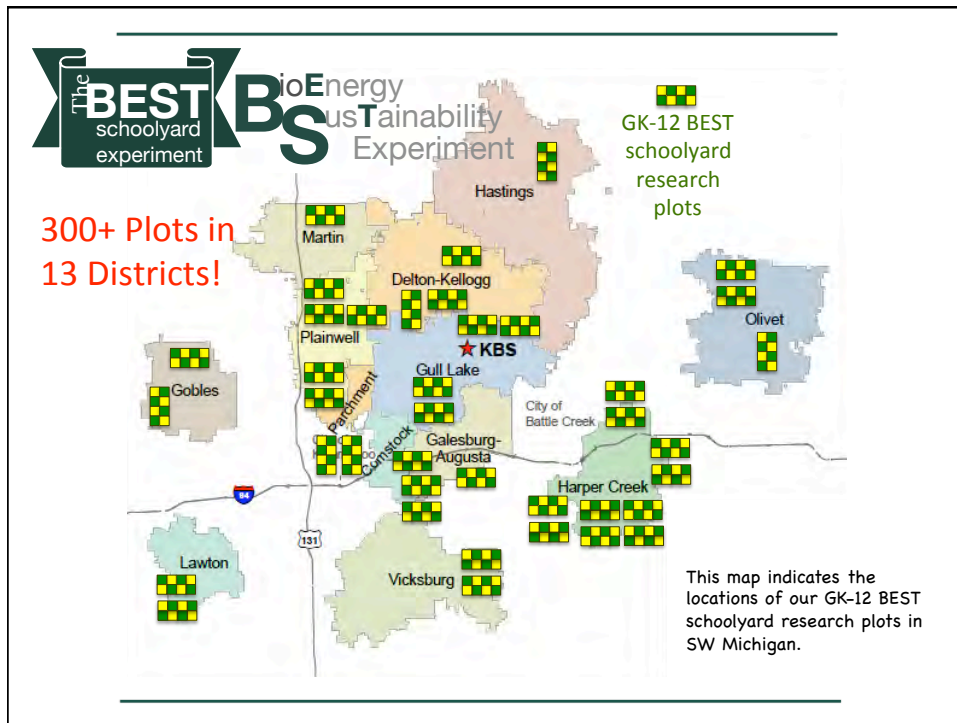


Our global hypothesis:

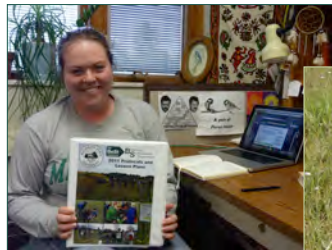
There are tradeoffs that will force compromises, but by understanding the basic ecological and social processes at play we can get good bioenergy production while sustaining biodiversity and ecosystem services at socially acceptable levels.

Fall 2010: Planted the Plots!





2010 School-year: designed and tested research protocols and teaching materials with students and teachers



Fall 2011: Official start to data collection!

External Evaluators Assess Project Success

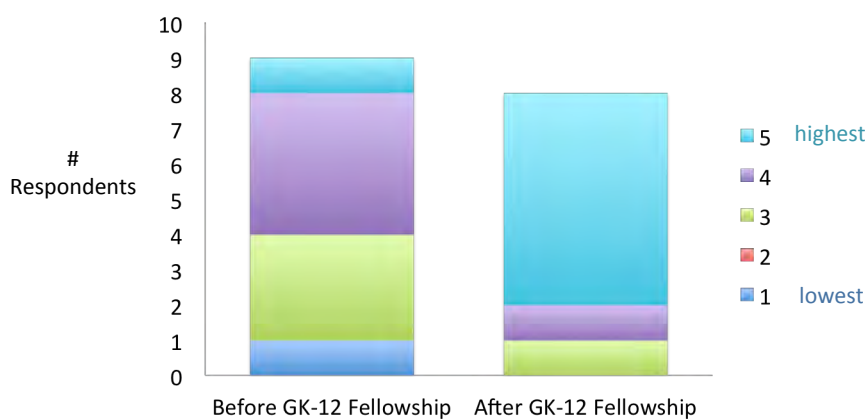
Common questions include:

- In what ways have GK-12 Fellows been affected by participation in the program?
- In what ways have participating teachers been affected?
- Have their students benefited?

Tools:

1. Pre- and Post-program surveys and interviews
2. Questionnaires at workshops and Summer Science Institute
3. Observation of Fellow presentations at workshops and in classroom
4. Student surveys in classrooms

Fellows report: increased ability to share science subject matter knowledge with partner teachers

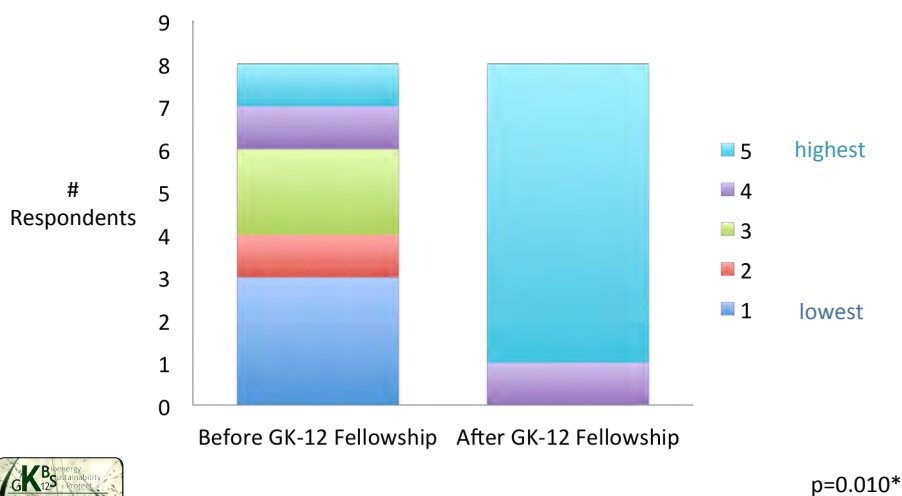


(Rate your ability to do the following on a 5 point scale)



p=0.011*

Fellows report:
**increased ability to introduce inquiry activities
addressing state and national science standards**



Fellows report:
**increased ability to put their own research
in broad societal and global contexts**



Fellow comments agree

How has this experience benefited your graduate career?

"I like the fact that it was mandatory for us to explain our research to our students...I feel that having this knowledge will make me a better instructor."

"It allowed me to use my research as a teaching implement which then provided me with continued interest in my work."

How has this experience helped you to better communicate science?

"I had to convey ideas, concepts etc. in a way that I had never considered before because I had to think of others' perspectives, prior knowledge, and needs."



Enhanced Teaching and Learning in K-12 Settings

On a scale from 1 to 5 (1 lowest) teachers rated the following:

Working with a resident scientist (RS) increased my ability to collaborate with someone knowledgeable about the subject I teach. Mean=4.43

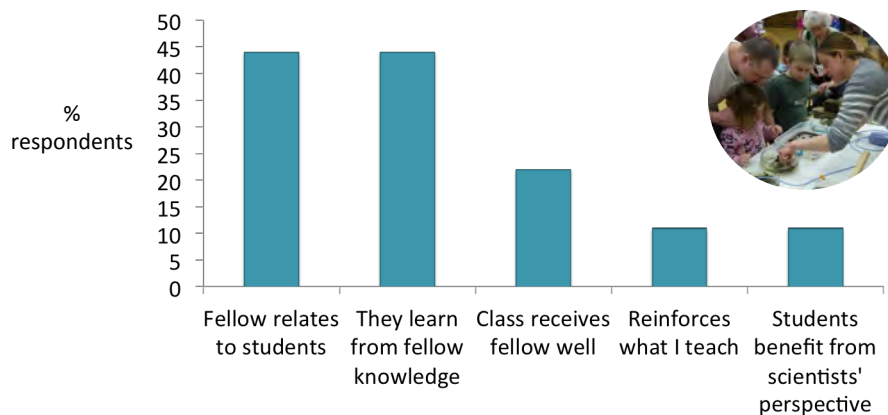
Working with a resident scientist promoted self-reflection about the subject I teach. Mean = 4.43

Also noted: Working with a resident scientist increased my students' interest in science.



Teachers Report: Impacts on Students

In what way(s) do you think students benefit from fellows' presence?



*Adds up to >100% because respondents gave >1 answer.

Contact Us

- <http://www.uncg.edu/bio/gk12/>
- <http://kbsgk12project.kbs.msu.edu>



MSU GK-12 Fellow Alycia Lackey
is here to answer questions

Acknowledgements:

UNC Greensboro and MSU-KBS
Leadership teams, fellows, and partner
teachers.

External evaluators: Western Michigan
University SAMPI evaluation team
including Robert Ruhf.





“With these kids, if you don't talk in their language, they stop you in your tracks, I'm helping them to see that **just because I'm a scientist doesn't mean I'm just babbling off big words**. I try to give them different ways to approach science.”

-Kristen Perez (UNC GK-12 Fellow)